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LOAD HANDLING APPARATUS

The present invention relates to apparatus for handling loads, particular for lifting, positioning and/or tilting large or small and/or heavy loads.

According to a first aspect of the present invention, there is provided load handling apparatus comprising at least one first elongate member having means for engaging a load and at least one second elongate member pivotally connected to said first-mentioned elongate member, and actuating means cooperating with said first and second elongate members to change the angular orientation of said first and second elongate members relative to each other.

The first member may engage directly with the load to be handled, or with additional elongate members disposed so as to transmit the relative movement of said first and second members to the load, which is thereby manipulated as required.

In its basic embodiment, the at least one first member is about twice the length of said at least one second member, but the invention also encompasses a variant in which the two members are of equal length. This latter embodiment may be achieved by affixing to the second member an extension member which lengthens the second member to a length which is equal to the first member. Alternatively, this latter embodiment may be achieved by providing the first member as a rigid member and the second member as a broken member comprising two pivotally connected arms of equal length.

It is preferred that said "at least one" first and second members actually each comprise a pair of members, which will hereinafter be referred to as the first pair and the second pair respectively, each member of each pair being disposed generally parallel to the other member of the same pair and the two pairs being connected together by means of a pivot rod.

The actuating means may comprise a hydraulic or pneumatic mechanism, but it is preferred

that the actuating means comprises an airbag which can be inflated by means of an airline, high pressure air bottle, battery operated compressor or the like. Alternatively, the airbag may be connected via suitable coupling means to a bolt-on air reservoir, such that the apparatus may be converted into a low profile self-levelling apparatus.

The airbag is conveniently disposed close to the point of pivotal connection between said first and second arms and is constructed such that inflation of the bag will cause a greater degree of inflation in the distal regions of the bag furthest away from the pivotal connection and a much lesser degree of inflation in the proximal region closest to the pivotal connection. Thus, the distal edge of the airbag inflates over an arc which is typically up to 90 degrees, such that the degree of tilt thereby imparted is up to 45 degrees.

Preferably, a lifting plate extends between the first pair of arms, which may also include means for connecting an attachment at an upper end thereof. Instead or in addition, a lifting table or platform may extend between the first and second pairs of arms (in the case where these are of equal length), to provide low profile vertical lifting upon inflation of the airbag.

However, the actuating means may alternatively be a hydraulically operated wedge device which may be driven laterally to achieve the same result.

According to a second aspect of the present invention there is provided an airbag having a number of interconnecting compartments, wherein inflation of the airbag is restrained at one edge or part thereof.

According to a third aspect of the present invention there is provided load handling apparatus comprising at least one first elongate member having means for engaging a load and at least one second elongate member pivotally connected to said first-mentioned elongate member, and an airbag cooperating with said first and second elongate members to change the angular orientation of said first and second elongate members relative to each other upon inflation/deflation of the airbag.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates one embodiment of the first aspect of the invention;

Figure 1A illustrates a variant of the embodiment of Figure 1;

Figure 2 is a plan view of the apparatus of Figure 1;

Figure 2A is a plan view of the embodiment of Figure 1A;

Figure 2B illustrates the extension member for connection to the apparatus shown in Figure 1;

Figure 3 illustrates a further embodiment of the first aspect of the invention;

Figure 4 is a plan view of the apparatus of Figure 3;

Figure 5a illustrates the use of a horizontal lifting platform;

Figure 5b illustrates a cross section along line XX' through the table part of Figure 5a;

Figure 6 is a plan view of the apparatus of Figure 5;

Figure 7 illustrates the use of multiple units of the apparatus of Figures 3 and 4;

Figure 8 illustrates the use of the unit of Figures 3 and 4 combined with the unit of Figures 1 and 2;

Figure 9 illustrates the use of the apparatus to discharge the contents of a container;

Figure 10 illustrates the use of an attachment;

Figures 11, 12 and 13 illustrate the method of construction of the airbag;

Figure 14 is a section through the constructed airbag;

Figure 15 illustrates schematically the inflation of the airbag of Figure 14;

Figure 16 illustrates the arrangement of Figure 1 but incorporating hydraulic actuating means in place of the airbag;

Figure 17 is a plan view of the apparatus of Figure 16;

Figures 18 through 20 illustrate the operation of the hydraulic mechanism;

Figures 21a-d illustrate a further embodiment of a first aspect of the invention;

Figures 22a & b and 23 illustrates a variant on an airbag according to an aspect of the invention; and

Figures 24a and 24b illustrate variants on a means for connecting two airbags to a common pivot.

The same parts in different Figures share common reference numerals, unless indicated otherwise.

Referring to Figures 1 and 2 of the drawings, a first pair of members 3 are pivotally connected, along pivot rod 7 (which may also hold the airbag to be described in detail later), to a second pair of members 10 of much shorter length than members 3 and terminating in free end 11 which has holes 11a or other fixing means to allow attachment of various accessories thereto. A top heavy duty or reinforced lifting plate 4 is disposed

between and attached to the upper regions of members 3 for engaging with a load, and a bottom reinforced lifting plate 2 is similarly disposed between and attached to the lower regions of members 10. The bottom edges of members 3 and 10 bear ground-engaging pairs of rollers 6 attached to the members by means of pivot pins 5. One of the roller pairs is fixed, the other slides horizontally. In Figures 1A and 2A, a platform, lifting device or order-picking device indicated schematically at 40 is fixed to the upper end of member 3.

Figure 2B illustrates an extension member 11b which is secured to end 11 of member 10 (see Figure 1) to form the embodiment shown in Figure 3.

In Figures 3 and 4, the second pair of members 1 are of the same length as members 3, this arrangement being suitable for the addition of a top table 8, as shown in Figure 5. Each of the upper ends of members 3 are pivotally connected to the underneath surface of top table 8 whilst the upper ends of members 1 travel horizontally on rollers 110 passing through respective channels 115 as the apparatus is operated. Also shown in Figure 5 is an inflatable airbag 9, which is a multi-compartment airbag according to the second aspect of the present invention, the airbag 9 being inflated to effect load handling. The airbag 9 is fixed to the pivot rod 7 by means of airbag holding strap 13.

In Figure 7, two units each comprising pairs of members 1,3 are linked together by pivot pins 5 to give greater height, the airbag 9 being disposed between the members of the lowermost unit.

In Figure 8, a unit comprising members 1,3 has connected on top of it, by means of pivot pins 5, a unit comprising members 3,10. The load 40 is supported between the uppermost pair of members 3, either on plate 4 or on the members themselves, and is secured against sliding off by removable stop means 18. At the base of the apparatus, rollers 6 travel within a base frame 12, the latter incorporating an anti-tilt locking device (not shown). The base frame 12 is itself mounted on wheels 42 and includes a towing bracket 15 so that the whole apparatus may readily be moved around as required.

In Figure 9, the same basic arrangement as shown in Figure 8 is illustrated, this time with an

extended flexible chute 21 extending from the upper surface of uppermost members 3. This variant is particularly suitable for discharging the contents of a container. A removable pivoting tilt stopper 20 is attached to members 3 as shown.

In Figure 10, the upper end of uppermost member has connected thereto a pivoting accessory attachment holder 17 which cooperates with support bar 22 to engage an accessory 23. The accessory 23 may be, for example, the functional equivalent of the blades of a fork lift truck, or loading platform, or stand-on platform such as is provided in conventional order-picking devices. The airbag is deflated to allow the bracket 23 to be engaged beneath the load to be lifted, and then inflated to lift the load. The interconnection of members 1,3 and 10 are such that the forces are transmitted along the apparatus in such a manner as to counterbalance the load, thus avoiding overturning. Another major advantage of the apparatus shown in Figure 10 is that the apparatus, having no permanently extended support arms, can be more readily manipulated in for example solid wall loading bays.

Figures 11 through 14 illustrate the method of construction of the airbag, which comprises alternate large and small sheets 1, 2 respectively joined by radio-frequency welding along lines 6,6a, B and C Corner reinforcements 5 serve to stabilise and strengthen the corners of the finished bag..

The sheets 1 and 2 have a central hole 8 therein surrounded by radio-frequency weld line 7, this hole serving to allow the air pumped into the bag from inlet 12 to rapidly fill the whole bag during inflation.

Large and small retaining straps 4, 4a are welded to the large sheets 1 as shown in Figure 13, along radio-frequency weld lines 3, and the airbag is bounded by small bottom sheet 9 and large top sheet 10, both without holes.

As can be seen in Figure 15, inflation of the bag by pumping air in through inlet 12 causes the bag to inflate as shown, with one side being restrained against inflation by means of retaining straps 4, 4a which are secured to bar 7. To deflate the bag, the air is simply let out of outlet 13 and the weight of the members or load returns the airbag to the deflated

condition.

In Figures 16 through 20, an alternative actuating means is illustrated, which comprises a hydraulic/pneumatic actuator 30. This comprises hydraulic/pneumatic cylinder 31 with a rear clevis 32 which mounts the cylinder onto the pivot rod 7. A rod 33 is extended and retracted relative to the cylinder 31, and top and bottom actuators 34, 34a respectively are pivotally mounted to the rod at hinge 35 with the free ends of actuators 34, 34a being preferably pivotally connected to members 3, 10 respectively of the handling apparatus. In the closed position as shown in Figure 18, the rod 33 is fully extended out of cylinder 31 and actuators 34, 34a lie flat against rod 33. However, upon retraction of rod 33 within cylinder 31 the actuators 34, 34a are forced, by virtue of their pivotal connection to members 3, 10 to pivot as shown in Figure 19 which represents the open position, thereby forcing members 3, 10 apart. Such an arrangement would require a hydraulic reservoir and motor, both of which would be located outside of the apparatus and are not illustrated in the drawings.

Figures 21a to d show a further embodiment of the load handling apparatus 40 which is capable of lifting a load and tilting a load two directions. In this embodiment, the apparatus includes a top table 42 for bearing a load, with removable, drop in, load safety bars 44,46 inserted in recesses (not shown). In this embodiment, each of the first pair of outer members 50 comprises a rigid member having a pivotally mounted roller 6 at a first and pivotally attached to the table at a second end 52. Each of the second pair of inner members 54, comprises an upper arm 56 and a lower arm 58 section of the same length and pivotally mounted on pivot rod 7. The first pair of outer members 50 are also pivotally mounted on pivot rod 7. The free end of the lower arm section 58 includes a rotatably mounted ground engaging roller or wheel 6. The free end of the upper arm section 56 includes a rotatably mounted roller or wheel 60 which runs upon and travels along an underside of the top table 42. A recessed channel (not shown) similar to that shown in Figures 5a and 5b is also provided, and through which respective rollers 60 run. The channels help to prevent the table from tipping over at larger angles. A first airbag 64 is provided between the first pair of members 50 and the upper arms 56 of the second pair of members, and is attached to the pivot rod. A second airbag 66 is provided between the first

pair of members 50 and the lower arms 58 of the second pair of members and is attached to the pivot rod.

With neither airbag inflated, as illustrated in Figure 21a, the table is in its lowest position. Inflation of either airbag alone, as illustrated in Figures 21b and 21c, causes the table to tilt to either side. Inflation of both airbags by the same amount causes the table to lift vertically. Inflation of the airbags by different amounts, as illustrated in Figure 21d, causes a composite lifting and tilting motion of the table. As will be appreciated, such a table could be used to lift a load vertically, before tipping to discharge the load onto a raised surface.

The apparatus includes push button controlled pneumatic circuitry to power the lifting apparatus (not shown).

Figures 22a & b and 23 shows a variant embodiment of the airbag aspect of the invention. The variant airbag 70 is similar to that shown in Figures 11 to 15 except for the construction of the means for fastening the air bag to the pivot rod 7. Retaining strap members 72 and 74 are attached by electronic welding at the interface 75 between a central large sheet 76 and small sheet 78. The end portion of strap 74 is attached by welding to strap 72 and in use loops around the pivot rod to connect the air bag to the lifting apparatus. As shown in Figure 23, providing the air bag fastening means at the centre of the air bag helps to retain the symmetry of the airbag in use and prevents its deformation in use, thereby improving its performance.

In order to connect two air bags to the common pivot rod 7, as required by the embodiment shown in Figure 21, the connecting straps require modifying from those shown in Figure 11, as illustrated in Figures 24a and 24b. One suitable modification would be to provide the first airbag with connecting straps 81 configured to attach only towards the ends of the pivot rod 7 while the second airbag's connecting straps 82 are configured to connect toward the middle of the pivot rod and between the straps of the first airbag. A further suitable modification would be to provided castellated respective connecting straps 83, 84 that intermesh to provide a robust connection for each airbag along the length of the pivot

rod.

It will be appreciated that the features of the various embodiments shown in the Figures can be added to one another, used with one another, or incorporated by making suitable modifications as would be clear to a man of ordinary skill in the present art.